Time Decay Constants of Resistive Detectors

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One of the biggest constraints in the operation of resistive detectors is the drop of their efficiency with the counting rate, attributed to the decrease of the charge gain. In order to clarify the origin of this problem, we carried out measurements of time variation of the charge pulse height from resistive detectors, operating in proportional regime, under high irradiation rates. The dynamic behaviour of these detectors was investigated through the determination of their time decay constants related to a stationary condition, where the charge gain becomes constant. To perform this study, a data acquisition system, which allows the users to observe in real-time the temporal variation of the energy spectrum, was specially designed.

A glass cylindrical proportional counter, filled with Ar + 10% CH_4 gas mixture at atmospheric pressure, was used to investigated the relaxation mechanisms associated with the resistive electrode. Measurements of the charge gains of these detectors, irradiated with different counting rates by 22 keV X-rays from a ^{109}Cd source, were carried out utilizing a conventional charge amplifier electronic system and a NIM ADC (ND582).

The first successfully results on the fitting of the peak centroid position as a function of time, obtained for rates range from 220Hz up to 1230Hz, showed it can be described by a sum of two exponentials plus a constant term, probably due to the complexity of the glass delayed polarization processes. The time decay constants extracted from these data decrease with increasing rates, what is in accordance with previous results. Furthermore, we also observed, for a fixed counting rate, an exponential decrease of the FWHM photopeak as a function of time. For this same condition, the area under the peak diminishes slightly as a consequence of the detector gain lowering. The physical interpretation of these results is under way.

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